ArevaEPRDCPEm Resource

From: Wunder, George
Sent: Tuesday, March 04, 2014 10:56 AM
To: ArevaEPRDCPEm Resource
Subject: FW: RAI 579 Q19-366 (discussion version)
Attachments: Response RAI 579 Q19-366 - Revision.pdf; RAI 579 S1 FSAR Markups.pdf

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From: HOTTLE Nathan (AREVA) [mailto:Nathan.Hottle@areva.com]
Sent: Thursday, February 27, 2014 9:44 PM
To: Eudy, Michael
Cc: Wunder, George
Subject: RAI 579 Q19-366 (discussion version)

Mike – Here are the files for discussion on Monday's public meeting. Note that this is for discussion only – it has not been through full QA review. The focus is on the Chapter 5 markups and what is needed to close Chapter 5. The RAI response is included for context so that we can discuss what will be sufficient to close Chapter 5.

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Request for Additional Information No.579, Supplement 1

4/12/2013
U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
SRSB Branch

Question 19-366:

In FSAR Section 5.4.7.2.1, Design Features Addressing Shutdown and Mid-Loop Operation, the FSAR states, " Safety injection via MHSI with reduced discharge head during low loop level ensures availability of the LHSI pumps for RHR function."

On page Table 3.3.1-1 (page 12 of 14), DCS Sensors, Function Processors, Manual Actuation Switches, and Trip Actuation Devices, the FSAR states that, " SIS Actuation on Low Hot Leg Loop in Modes 5 and 6 with a setpoint of 18.9 inches in the hotleg" with note (o) "With P15 permissive validated" and note (u) "With Manual SIS - Loop Level Bypass inhibited."

The staff then reviewed insight 20 on Table 19.1-108 - US EPR PRA Based Insights. Insight 20 reads, "In shutdown operation, automatic MHSI actuation on a low RCS (hot leg) loop level....". The staff found no discussion in Chapter 19 in the FSAR on the use of the Loop Level Bypass switch that is shown on FSAR Figure 7.3-2 - SIS actuation. The staff also found no discussion in Section 5.4.7.2.1 on the use of the bypass switch. Based on discussions with AREVA at the US EPR audit in February of 2013, use of this bypass switch that would prevent automated safety injection was not modeled in the PRA. Based on conversations with AREVA at the US EPR audit, this bypass switch may be used to prevent automatic actuation of Safety Injection when personnel are performing hot leg and cold leg work (such as installing nozzle dams), the highest risk period during an outage. It was also unclear if this bypass switch would be used during reactor vessel head removal operations. Based on discussions with AREVA staff at the audit, it seems that no criteria was developed documenting when the loop level bypass would be used.

(1) The staff is requesting that FSAR Chapters 19.1.6 and Chapter 5.4.7.2.1 be revised to account for use of this RCS loop level bypass switch that would prevent automated safety injection during reduced inventory operation when used.

(2) The staff is requesting AREVA to re-quantify the EPR LPSD PRA, the sensitivity studies, the importance analysis, and dominant cutsets with the SIAS removed since there is no documented criterion as to when this bypass would be used for POSs CB and D.

(3) The staff is requesting AREVA to update the FSAR Section 5.4.7.2.1 and Chapter 19 to include information specifying the location of the upper and lower instrumentation taps for the hot leg level indication

(4) The EPR PRA did not specifically model nozzle dam installation since it was considered an infrequent evolution. The EPR PRA assumes that the core will offloaded every fuel cycle. The FSAR should either include the full core offload as a COL holder item or assess the risk from nozzle dam installation. If nozzle dams are used, to ensure that the risk of a sudden loss of RCS inventory during nozzle dam installation/removal and cold leg work does not invalidate the results of the EPR PRA, the staff is requesting EPR to update the US EPR risk insight 82 and Section 5.4.7 of the FSAR to state that the following recommendations will be implemented consistent with GL 88-17 and IN 88-36. These important operator actions needs to be documented as risk significant operator actions in Chapter 19 of the FSAR:

(a) A pressurizer manway (if analysis shows this to be a sufficient vent path) or otherwise create a suitable opening to limit the pressurization which could follow an extended loss of DHR while the nozzle dams and the reactor vessel head are in place.

(b) A hotleg manway will be the first manway to be opened, and a hot leg nozzle dam will be the last dam to be installed.

(c) A hot leg manway and its associated hot leg pipe will be kept open to provide an adequate vent path whenever any cold leg openings are made.

(d) The expeditious actions in GL - 88-17 will be implemented.

(5) The EPR CDF from overdraining the RCS to reach midloop conditions (UCLD) is reported as approximately 8E-9 per calendar year. This reduction, which is orders of magnitude lower than current PWR operating data, is based on (1) failure of automatic isolation of CVS on low hot leg level and (2) failure of the operator to terminate the drain down if the automatic isolation fails. This operator failure was assumed to be an exceptionally small likelihood of 5E-5. In order for the staff to evaluate the risk of overdraining, AREVA is requested to document in Chapter 19 and Section 5.4.7.2.1 of the FSAR (a) the hotleg level at which SG nozzle dams are to be installed (b the hot leg level/set point at which this automatic isolation is supposed to occur, (c) the highest hot leg level at which vortexing is expected to initiate in the hotleg given a RHR flow rate of 2250 gpm required by TS surveillance testing, (d) the highest anticipated RCS drain rate during reduced inventory operations, and (e) a discussion of how the midloop tests referenced in FSAR Section 14.2.12.2.5 Mid-Loop Operations Verification (Test #017) will confirm item (d) above.

Response to Question 19-366:

Item (1):

The original purpose of the SIS bypass switch was to disable the automatic safety injection to provide personnel protection for some RCS maintenance related activities during shutdown conditions. A subsequent evaluation of the use of the SIS bypass switch has led to the conclusion that the SIS bypass switch cannot be used for this intended function, and for that reason will be eliminated from the U.S. EPR design.

Along with this change, AREVA is revising the existing Technical Specifications for automated SIS in mode 5 (Technical Specification 3.5.8) to allow for controlled evolutions into RCS maintenance with fuel still in the core.

With the revised Technical Specifications controlling the disabling of the automatic SIS actuation in mode 5, the COL item added to control the use of nozzle dams will be revised to more generally assess the risk (impact on the PRA and risk significant human actions) associated with RCS maintenance performed with fuel in the vessel, including RCS maintenance involving the use of nozzle dams.

Elimination of the SIS bypass switch and revision of the Technical Specifications are incorporated as follows into the FSAR:

- U.S. EPR Tier 2 Figure 7.3-2 is revised to remove the bypass switch.
- U.S. EPR FSAR Tier 2 Section 7.3.2.1 is revised to remove discussion of the bypass switch.
- Technical Specification 3.3-2 and bases is modified to remove the bypass switch

- Technical Specification 3.5.8 and bases is revised to add a note to allow disabling of automatic SIS injection in mode 5 when required for personnel protection during RCS maintenance.
- U.S. EPR Tier 2 Section 5.4.7.2.1 will be revised to:
    - eliminate discussion of the bypass switch
    - reference the note added to Technical Specification 3.5.8
    - describe strategy for managing shutdown risk during infrequent RCS maintenance activities
    - revise the added COL item on the use of nozzle dams as described above.
- U.S. EPR Tier 2 Table 1.8-2 will be revised to change the COL item on the use of nozzle dams as described above.
- U.S. EPR Tier 2 Chapter 19 **[To Be Determined]**

Item (2):

The design changes described in Item 1 above will be evaluated under the PRA update and maintenance process for incorporation into the Design Certification PRA.

As shown in the 5.4.7.2.1 FSAR markup, routine RCS maintenance is expected to be performed during a full fuel offload. The frequency of automatic MHSI disabling for personnel protection will be limited to infrequent RCS maintenance, such as mid-cycle shutdown for component repair. The duration of automatic MHSI disabling is controlled by a note that is added to Technical Specification 3.5.8.

When MHSI is disabled, compensatory actions will be taken to provide reasonable assurance that the MHSI function can be promptly restored. Thus, the impact of disabling automatic MHSI is minimized.

U.S. EPR FSAR Section 19.1 will be revised to reflect that the impact of the design changes described in Item 1 will be evaluated by a sensitivity study.

Item (3):

The upper and lower instrument taps for the hot leg indication are installed on the top and bottom of the horizontal part of the hot leg. The level sensor taps are located on each hot leg approximately ten feet from the steam generator centerline and approximately six feet closer to the steam generator than the low head safety injection residual heat removal (LHSI RHR) discharge nozzle. U.S .EPR FSAR, Tier 2, Section 5.4.7.2.1 was previously revised to describe the location of the instrument taps. U.S .EPR FSAR, Tier 2, Section 19.1.6.1.7 will be revised to describe the location of the instrument taps as modeled in the PRA.

Item (4):

U.S. EPR FSAR Tier 2 Section 5.4.7.2.1 will be revised to reflect that RCS maintenance requiring draining of the system to below the top of the hot leg (including the use of nozzle dams) is not anticipated to be performed during a normal refueling outage to extend the RCS maintenance window. However, nozzle dams may be used with fuel in the reactor vessel for

infrequent RCS maintenance activities, like a mid-cycle outage to repair a steam generator tube leak.

During nozzle dam installation and removal, there is a risk of a sudden loss of reactor coolant system (RCS) inventory. This risk is reduced by the mid-loop level control and protection features described in U.S. EPR FSAR Tier 2, Section 5.4.7.2.1, but not totally eliminated.

U.S. EPR FSAR, Tier 2, Section 5.4.7.2.1 was previously modified to:

- Require removal of the pressurizer manway if nozzle dams are used with the reactor head installed.
- Require that a hot leg manway will be the first manway to be opened, and a hot leg nozzle dam will be the last dam to be installed.
- Require a hot leg manway and its associated hot leg pipe to be kept open to provide an adequate vent path whenever any cold leg openings are made.
- Require the expeditious actions in GL 88-17 to be implemented.

Item (5):

U.S. EPR FSAR Tier 2, Section 5.4.7.2.1 was previously revised to provide information on RCS loop level controls.

As described in Item 2 above, a PRA sensitivity study will be performed to access the risk impact of the design changes described in Item 1 above. PRA insights and assumptions on modeling of operator actions associated with the sensitivity model will be incorporated using the PRA update and maintenance process as described in U.S. EPR FSAR Section 19.1. Highlights of this PRA analysis will include the following:

- The core damage frequency (CDF) associated with the UCLD overdraining will reflect (1) failure of automatic isolation of CVCS on low hot leg level, (2) failure of the operator to terminate the drain down if the automatic isolation fails, and (3) failure to recover MHSI if it has been disabled.
- The time available for compensatory operator actions will be determined based on the pertinent RCS conditions. These results are expected to demonstrate that the operators have in excess of 20-30 minutes to recover MHSI.
- The human error probabilities associated with taking these compensatory actions will be determined using the methodology described in Tier 2 FSAR Section 19.1.4.1.1.5. The risk increase associated with mid-loop operation is expected to be in the 8 – 16% range. If additional constraints (e.g., minimum time to entry to mid-loop) are required to limit the delta CDF increase, these will be imposed as needed.

Mid-Loop Operations Verification (Test #017) will not confirm the highest anticipated RCS drainage rate during reduced inventory operations. Rather, the effects of the unisolated letdown path will be characterized in the determination of the available time for compensatory actions.

FSAR Impact:

U.S. EPR FSAR Tier 2 Sections 5.4.7.2.1 and 19.1.6.1.7, and Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Chapter 16, Technical Specifications 3.3.2 and 3.5.8, and associated Bases will be revised as described in the response and indicated on the enclosed markup.

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 19 of 41

RAI 579, Q. 19-366

Item No.	Description	Section
5.4-2	A COL applicant that references the U.S. EPR design certification will assess the risk (impact on the PRA and risk significant human actions) associated with RCS maintenance performed with fuel in the vessel,~~the use of nozzle dams if they are to be used for normal refueling outages~~.	5.4.7.2.1
6.1-1	A COL applicant that references the U.S. EPR design certification will review the fabrication and welding procedures and other QA methods of ESF component vendors to verify conformance with RGs 1.44 and 1.31.	6.1.1.1
6.1-2	A COL applicant that references the U.S. EPR design certification will define a coating application and maintenance program for components that cannot be procured with DBA qualified coatings in accordance with 10 CFR 50 Appendix B, Criterion IX.	6.1.2.3.2
6.1-3	A COL applicant that references the U.S. EPR design certification will define the coatings program and its implementation, including maintenance and repair of coatings.	6.1.2.2.2
6.2-1	A COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the CLRT program described under 10 CFR 50, Appendix J.	6.2.6
6.3-1	A COL applicant that references the U.S. EPR design certification will describe the containment cleanliness program which limits debris within containment.	6.3.2.2.2
6.4-1	Deleted.	Deleted
6.4-2	A COL applicant that references the U.S. EPR design certification will provide written emergency planning and procedures in the event of a radiological or a hazardous chemical release within or near the plant, and will provide training of control room personnel.	6.4.3
6.4-3	A COL applicant that references the U.S. EPR design certification will evaluate the results of the toxic chemical accidents from Section 2.2.3, address their impact on control room habitability in accordance with RG 1.78, and if necessary, identify the types of sensors and automatic control functions required for control room operator protection.	6.4.1
6.4-4	A COL applicant that references the U.S. EPR design certification will confirm that the radiation exposure of main control room occupants resulting from a design basis accident at a nearby unit on a multi-unit site is bounded by the radiation exposure from the postulated design basis accidents analyzed for the U.S. EPR; or confirm that the limits of GDC-19 are met.	6.4.4

- Inherent redundancy in the design of the four divisions of safety-related U.S. EPR SIS/RHRS, with each train having separate RCS connections.
- Automatic SIS Actuation (Protection System) and automatic stop of the LHSI pumps in RHR mode (PAS) in the event of a low loop level or low delta-P_{sat} (difference between the RCS hot leg temperature and the RCS hot leg saturation temperature). See Figure 7.3-2—SIS Actuation.
- Manual opening and closure of the RHR suction isolation valves (in addition to interlocks) prevent unwanted RHR connection or isolation on irregular RCS pressure. See Figure 7.6-11—RHR Isolation Valves Interlock.

RAI 579, Q. 19-366

Automatic safety injection via MHSI with reduced discharge head during low loop level ensures availability of the LHSI pumps for the RHR function. A note in Technical Specification 3.5.8 allows this automatic actuation feature to be removed from service temporarily for personnel protection during selected RCS maintenance activities.

- Routine RCS maintenance (e.g., refueling) will be performed during a full fuel offload.
- Infrequent RCS maintenance (e.g., mid-cycle steam generator repair) will be performed subject to the note in Technical Specification 3.5.8. During these infrequent RCS maintenance activities, automatic MHSI actuation may be disabled (as needed) to ensure personnel protection when fuel is in the reactor vessel. When this provision in Technical Specification 3.5.8 is used, compensatory actions will be taken to provide reasonable assurance that the MHSI function can be promptly restored to manage the plant risk. The risk associated with disabling and restoring MHSI during these evolutions is discussed further in Chapter 19. Additionally, a COL applicant that references the U.S. EPR design certification will assess the risk (impact on the PRA and risk significant human actions) associated with RCS maintenance performed with fuel in the vessel.

- The RHR connection will be automatically isolated in the event of a break outside of the containment, based on the safeguard building sump level and pressure sensors. This non-safety function is performed by PAS.

- Spring-loaded safety relief valve, located at the RHR hot leg suction line, protects the SIS/RHRS against over-pressurization when in RHR mode.

- During mid-loop operations, a maximum RHR flow rate will be established which minimizes the probability of suction pipe vortexing while providing adequate decay heat removal.

- Redundant hot leg level sensors that initiate RCS make-up (safety and non-safety related) when the RCS hot leg has reached low level.

- When nozzle dams are installed the following recommendations will be implemented:

  – Removal of the pressurizer manway while the nozzle dams are installed and the reactor vessel head is in place. This action limits the pressurization of the RCS and inboard side of the nozzle dams which could follow an extended loss of decay heat removal.

  – A hot leg manway will be the first manway to be opened.

   - A hot leg nozzle dam will be the last dam to be installed.
   - A hot leg manway and its associated hot leg pipe will be kept open to provide an adequate vent path whenever any cold leg openings are made.
   - The expeditious actions in GL 88 17 to be implemented any time that nozzle dams are installed.

- During mid-loop operation, the RCS loop level is normally controlled by the CVCS low pressure reducing valve to ensure there is sufficient RCS water inventory for operation of the LHSI pumps in RHR mode. The level control, limitation, and protection features are described below:

Loop Level Control Function	The RCS loop level control during mid-loop operation is regulated by the CVCS high pressure charging pumps and CVCS low pressure reducing station. After the loop level control mode has been manually validated, certain automatic protection functions are actuated.
Max1 RCS Loop Level Limitation Function	This setpoint initiates an open command for the CVCS low pressure letdown control valve in order to prevent inadvertent filling of the steam generator bowls (without nozzle dams).

Min1 RCS Loop Level Limitation Function	This setpoint initiates full closure of the CVCS low pressure letdown control valve and the RHR and CVCS isolation valves in order to protect the LHSI pumps that are operating in RHR mode. This function covers the entire temperature range of the RHR system operation.
Min1p RCS Loop Level Safety Function	This setpoint initiates the SIS in case of low RCS level in the primary loops in the event of a sudden drop in RCS level during mid-loop operation in order to protect the RHR pumps and maintain adequate core cooling.

- The reactor pressure vessel (RPV) water level is continually monitored during outage with a level sensor. The level sensor taps are located on the top and bottom of each hot leg approximately ten feet from the steam generator center line and approximately six feet closer to the steam generator than the LHSI RHR discharge nozzle.

RAI 579, Q. 19-366

- Temperature sensors, located at the RCS hot legs, allow temperature measurement of each hot leg when in a reduced inventory condition.

~~Nozzle dams are not anticipated to be used during normal refueling outages to extend the steam generator maintenance window. The U.S. EPR certified design is based on a full fuel offload, and assumes use of nozzle dams only in case of a rare mid-cycle outage for a steam generator tube repair. A COL applicant that references the U.S. EPR design certification will assess the risk (impact on the PRA and risk significant human actions) associated with the use of nozzle dams if they are to be used for normal refueling outages.~~

5.4.7.2.2 Design Features Addressing Intersystem LOCA

The design features of the SIS/RHRS that address the intersystem LOCA section of Reference 17 and SECY 90-016 (Reference 18) are as follows:

- Codes and Standards / Seismic Protection – The portions of the SIS/RHRS interfacing with the RCS and located outside the containment building (in the safeguard buildings) are classified as Quality Group B and Seismic Category I so that the design, manufacture, installation, and inspection of this pressure boundary is in accordance with ASME Boiler and Pressure Vessel Code, Section III, Class 2 Components.

- Increased Design Pressure – The portions of the SIS/RHRS from the RCS to the second reactor coolant pressure boundary (RCPB) isolation valves are designed to the RCS design pressure, and are classified as Quality Group A (ASME Boiler and Pressure Vessel Code, Section III, Class 1 Components) and Seismic Category I. This provides an additional barrier between the RCS and the lower pressure portions of the SIS/RHRS. The remaining portions of the SIS/RHRS are designed so that the ultimate rupture strength exceeds that of the full RCS operating pressure.

(RCP) shut down. It is bypassed above the P15 thresholds. ~~A manual bypass of SIS actuation on low hot leg loop level is provided for protection of personnel working in the RCS components during outages.~~

The logic for generation of the P12 and P15 permissive signals is described in Section 7.2.1.3.7 and Section 7.2.1.3.10.

The capability for manual system-level initiation of the SIS is provided to the operator on the SICS in the MCR. This manual system-level initiation starts the four trains of safety injection as well as the associated protective actions, such as partial cooldown and reactor trip. For an SG tube rupture (SGTR) event, the operator is credited to perform a manual system-level initiation of SIS from the SICS. Four manual system-level initiation controls are provided, any two of which will start the four SIS trains.

The capability for component-level control of the SIS actuators is available to the operator on both the PICS and the SICS in the MCR. Operator actions credited in mitigating accidents are addressed in Section 15.0.0.3.7.

Reset of the SIS actuation sense and command output is available from the SICS in the MCR and RSS. A reset of the SIS actuation output does not result in stopping the actions of the SIS actuators; it allows the operator to take further actions to stop specific trains of safety injection or manipulate individual components as may be necessary to follow plant operating procedures.

The logic for the SIS actuation function is shown in Figure 7.3-2—SIS Actuation.

7.3.1.2.2 Emergency Feedwater System Actuation

To mitigate the effects of a loss of main feedwater (MFW) event, the emergency feedwater system (EFWS) is actuated as a safety-related means to remove residual heat via the steam generators (SG). A number of failure mechanisms can result in loss of MFW (e.g., feedwater line break, loss of offsite power, feedwater pump failure). Regardless of the initiating event, a low SG level condition is characteristic of a loss of MFW and is used to actuate the EFWS.

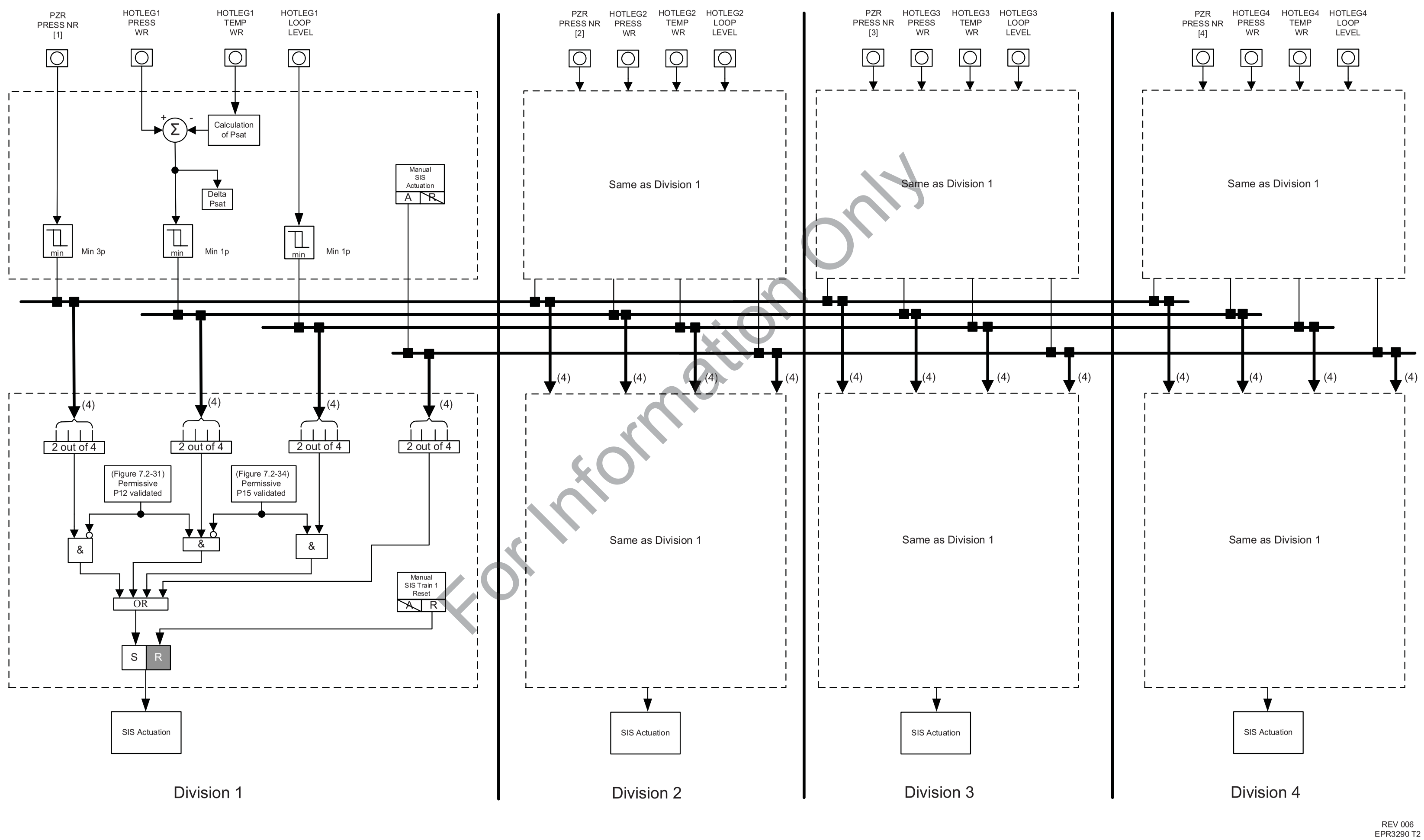
An anticipatory EFWS actuation is also included to cope with the possibility of a loss of offsite power (LOOP), concurrent with a LOCA, to enhance natural circulation cooldown.

The operation of the EFWS is described in Section 10.4.9.

The U.S. EPR design uses the following initiating conditions to actuate the EFWS:

- SG level (WR) < Min2p.
- Loss of offsite power (LOOP) and SIS actuation signals generated.

Figure 7.3-2—SIS Actuation



3.3 INSTRUMENTATION

3.3.2 Engineered Safety Feature Actuation System (ESFAS) Instrumentation

LCO 3.3.2 The ESFAS instrumentation for each Function in Table 3.3.2-1 shall be OPERABLE.

RAI 579, Q. 19-366

APPLICABILITY: According to Table 3.3.2-1.

~~-- NOTE --~~
~~The SIS Actuation - Low Hot Leg Loop Level signal may be bypassed for up to 1 hour while personnel are working in RCS components.~~
~~--~~

ACTIONS

-- NOTE --
Separate Condition entry is allowed for each Function.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more Functions with one or more divisions inoperable.	A.1	Enter the applicable Condition referenced in Table 3.3.2-1.	Immediately
B. One Input & Acquisition Logic division inoperable.	B.1	Verify Actuation Logic voting is modified.	6 hours
C. One required Input & Acquisition Logic division inoperable.	C.1	Verify Actuation Logic voting is modified.	6 hours
	<u>AND</u>		
	C.2	Restore required Input & Acquisition Logic division to OPERABLE status.	72 hours

Table 3.3.2-1
ESFAS Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED NUMBER	CONDITIONS	SURVEILLANCE REQUIREMENTS
1. SIS Actuation				
a. Low Pressurizer Pressure	1,2,3[a]	4 divisions	B,D,O	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
b. Low Delta P_{sat}	3	4 divisions	B,D,P	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
	4[b][e]	3 divisions	B,D,P	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
c. Low Hot Leg Loop Level	4[f]~~[m]~~	3 divisions	C,M	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
	5[f]~~[m]~~,6[f]~~[m]~~	2 divisions	K	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
d. Manual	1,2,3	4 divisions	F,H,Q	SR 3.3.2.5
	4	3 divisions	E,M	SR 3.3.2.5
	5,6	2 divisions	X	SR 3.3.2.5
2. EFWS Actuation				
a. Low-Low SG Level (Affected SG)	1,2,3[c]	4 divisions	B,D,Q	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.6 SR 3.3.2.7
b. Manual (Affected SG)	1,2,3	4 divisions	I,J	SR 3.3.2.5
	4[c][k]	2 divisions	EE,FF	SR 3.3.2.5

RAI 579, Q. 19-366

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED NUMBER	CONDITIONS	SURVEILLANCE REQUIREMENTS

(a) With P12 inhibited (Pressurizer Pressure Higher than Setpoint).

(b) With P12 validated (Pressurizer Pressure Lower than Setpoint).

(c) With P13 inhibited (Hot Leg Temperature Higher than Setpoint).

(d) With P14 inhibited (Hot Leg Pressure or Hot Leg Temperature Higher than Setpoints).

(e) With P15 inhibited (Hot Leg Pressure or Hot Leg Temperature Higher than Setpoints or RCP in Operation).

(f) With P15 validated (Hot Leg Pressure and Hot Leg Temperature Lower than Setpoints and No RCP in Operation).

(g) With P17 validated (Cold Leg Temperature Lower than Setpoint).

(h) When MHSI Large Miniflow Valves and PSRV OPERABILITY are required by LCO 3.4.11, Low Temperature Overpressure Protection (LTOP).

(k) When the SGs are relied upon for heat removal.

(m) ~~With Manual SIS - Loop Level Bypass inhibited~~Deleted. RAI 579, Q. 19-366

(n) See LCO 3.3.4, Containment Isolation Instrumentation, for Input & Acquisition Logic division OPERABILITY, ACTION, and Surveillance Requirements.

(o) Except when all Main Feedwater Full Load isolation valves are closed and deactivated.

(p) Except when all Main Feedwater Full Load and SSS isolation valves are closed and deactivated.

(r) Except when all Main Steam isolation valves are closed and deactivated.

(s) See LCO 3.3.1, Reactor Trip Instrumentation, for Input & Acquisition Logic division OPERABILITY, ACTION, and Surveillance Requirements.

(t) With reactor trip initiated.

(u) P14 permissive is used for setpoint selection.

(v) With P18 validated (Hot Leg Temperature Lower than Setpoint or Reactor Trip).

(w) With P16 validated (Hot Leg Pressure Lower than Setpoint).

(z) During movement of irradiated fuel assemblies.

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.8 ECCS - Shutdown, MODES 5 and 6

LCO 3.5.8 Two Medium Head Safety Injection (MHSI) trains shall be OPERABLE.

--- NOTE ---
The required OPERABLE MHSI trains may be removed from service for up to 48 hours with vessel level at or above mid-loop reactor vessel level provided no operations are permitted that would cause perturbation of RCS inventory.

RAI 579, Q. 19-366

APPLICABILITY: MODE 5,
MODE 6 with the refueling cavity not filled.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required MHSI train inoperable.	A.1 Restore required MHSI train to OPERABLE status.	72 hours
B. Two required MHSI trains inoperable.	B.1 Initiate action to restore at least one MHSI train to OPERABLE status.	Immediately
C. Required Action and associated Completion Time not met.	C.1.1 Initiate action to be in MODE 5 with the RCS pressure boundary intact and ≥ 25% pressurizer level.	Immediately
	<u>OR</u>	
	C.1.2 Initiate action to achieve refueling cavity water level ≥ 23 feet above the reactor vessel flange.	Immediately
	<u>AND</u>	
	C.2 Suspend positive reactivity additions.	Immediately

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.8 ECCS - Shutdown, MODES 5 and 6

LCO 3.5.8 Two Medium Head Safety Injection (MHSI) trains shall be OPERABLE.

-- NOTE --
The required OPERABLE MHSI trains may be removed from service for up to 24 hours with vessel level at or above mid-loop reactor vessel level provided no operations are permitted that would cause perturbation of RCS inventory.

RAI 579, Q. 19-366

APPLICABILITY: MODE 5,
MODE 6 with the refueling cavity not filled.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required MHSI train inoperable.	A.1 Restore required MHSI train to OPERABLE status.	72 hours
B. Two required MHSI trains inoperable.	B.1 Initiate action to restore at least one MHSI train to OPERABLE status.	Immediately
C. Required Action and associated Completion Time not met.	C.1.1 Initiate action to be in MODE 5 with the RCS pressure boundary intact and ≥ 25% pressurizer level.	Immediately
	OR	
	C.1.2 Initiate action to achieve refueling cavity water level ≥ 23 feet above the reactor vessel flange.	Immediately
	AND	
	C.2 Suspend positive reactivity additions.	Immediately

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The specific safety analysis and OPERABILITY requirements applicable to each protective function are identified below. Permissives that enable a credited function are included in the Technical Specifications.

RAI 579, Q. 19-366

~~The Applicability requirements have been modified by a Note indicating that the SIS Actuation – Low Hot Leg Loop Level signal (1.c) may be bypassed for up to an hour while personnel are working in RCS components.~~

LCO 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation," addresses the following Functions:

1. <u>Safety Injection System (SIS) Actuation</u>

a. SIS Actuation - Low Pressurizer Pressure

In the event of a decrease in RCS water inventory, the makeup is supplied by the Medium Head Safety Injection (MHSI) in the high pressure phase of the event and the Low Head Safety Injection (LHSI) in the low pressure phase. For a potential overcooling event, the reactivity insertion is limited by the boron injection via the MHSI. Even if the boron injection is not required, MHSI injection is needed to stabilize the RCS pressure. This Function mitigates the following postulated accidents or AOOs:

– Excessive increase in secondary steam flow,
– Steam Generator Tube Rupture (SGRT),
– Small break LOCA,
– Inadvertent opening of a pressurizer pilot operated safety valve,
– MSLB,
– Large break LOCA.

Four divisions of the SIS Actuation - Low Pressurizer Pressure Function are required to be OPERABLE in:

– MODES 1, 2, and
– MODE 3 with P12 permissive inhibited.

This Function utilizes the Pressurizer Pressure (Narrow Range) sensors.

The NTSP is sufficiently below the full load operating value for RCS pressure so as not to interfere with normal plant operation. However, the NTSP is high enough to provide an SIS actuation during an RCS depressurization.

BASES

LCO (continued)

RAI 579, Q. 19-366

During an event requiring ECCS MHSI actuation, a flow path is required to provide an abundant supply of water from the IRWST to the RCS via the ECCS pumps and to its associated four cold leg injection nozzles.

The LCO modified by a Note allows the required OPERABLE MHSI trains to be removed from service for up to 48 hours for personnel protection during RCS maintenance activities, such as installation of nozzle dams and replacement of reactor coolant pump seals, provided no operations are permitted that would cause perturbation of RCS inventory.

APPLICABILITY

In MODES 1, 2, and 3, the OPERABILITY requirements for ECCS are covered by LCO 3.5.2. MODE 4 OPERABILITY is covered by LCO 3.5.3.

In MODES 5 and 6, two OPERABLE ECCS MHSI trains are acceptable and provide for single failure consideration.

Core cooling requirements in MODE 5 are addressed by LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled," and LCO 3.4.8, "RCS Loops - MODE 5, Loops Not Filled." MODE 6 core cooling requirements are addressed by LCO 3.9.4, "RHR Loops - High Water Level," and LCO 3.9.5, "RHR Loops - Low Water Level."

ACTIONS

A.1

With one required MHSI train inoperable, the inoperable MHSI train must be returned to OPERABLE status within 72 hours. The 72 hour Completion Time is based on an NRC reliability evaluation (Ref. 5) and is a reasonable time for repair of many ECCS components.

An ECCS MHSI train is inoperable if it is not capable of delivering design flow to the RCS. Individual components are inoperable if they are not capable of performing their design function or supporting systems are not available.

B.1

If two required ECCS MHSI trains are inoperable, immediate action must be taken to restore at least one MHSI train to OPERABLE status.

- RCS - Use of nozzle dams is not modeled in the LPSD PRA because they are not anticipated to be used in normal refueling outages. The U.S. EPR design is based on a full fuel offload, and use of nozzle dams is assumed only for cases of infrequent RCS maintenance activities, like mid-cycle outages for steam generator tube repair.

- CVCS – Charging pumps aresystem is not credited in shutdown.

- EFW – Auto reset of the P13 permissive is required for automatic EFW operation during POS C. Also, only the normal pressure control mode of MSRTs is required (MSSVs are not credited). A PCD function is disabled by P14 permissive, the MSRT pressure is set to 145 psia and is not automatically reset.

- RCP – Only two pumps are running during POS CAD and would be required to trip upon loss of motor cooling. Seal cooling is not required during shutdown.

The following summarizes LPSD systems with auto actuation signals modeled:

- RHR protective trip – Low loop level will trip the operating RHR pumps to protect the pumps and allow them to be restarted post trip either in RHR or the LHSI mode of operation. The level sensor taps are located on the top and bottom of each hot leg approximately ten feet from the steam generator center line and approximately six feet closer to the steam generator than the LHSI RHR discharge nozzle. This non-safety function is performed by PAS. Failure of this trip function is included as a failure mode of the RHR pumps. Success allows the pump to be manually recovered later.

- RHR isolation – High sump level in the SB automatically isolates the respective RHR train and trips the pump. This non-safety function is performed by PAS. and This is modeled in the RHR ISLOCA initiating event fault tree.

- Low pressure reducing station isolation – During an uncontrolled drain down event (ULD), low loop level automatic isolation of the low pressure reducing station is modeled. This non-safety function is performed by PAS; it initiates closure of the CVCS letdown in order to protect the RHR pumps and prevent challenge of the SIAS safety function. Failure is also assumed to result in diversion of IRWST water outside containment requiring operator response.

The probability of plugging the IRWST suction strainers is modeled the same as at-power operation (i.e., CCF). Maintenance work during shutdown could result in a higher probability of plugging. However, the IRWST design is somewhat unique in comparison to the PWR plants operating in the USA. The structure is very large with separation between suction lines to the four SB; three levels of filters are also provided: trash racks, retaining baskets, and six strainers with a back flush capability. This probability of plugging is also dependent on maintenance procedures that will be in place to control foreign material, but are not available in this phase. As a result, the present modeling of the IRWST suction strainers was not changed.